

Developing A Framework to Assess Students' Contributions during Wiki Construction

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Abstract

The emergence of Web 2.0 technologies and their increasing use in higher education have provided opportunities for building collaborative learning environments for students. Collaborative experiences are particularly beneficial for preparing students for their future workplace environments. Moreover, the creation and sharing of resources and information as afforded by Web 2.0 technologies can also improve a student's learning experience.

Web 2.0 technologies such as wikis can be used to enable and support new and varied forms of group work learning. Wikis provide tools for measuring students' contributions, such as the number, size and regularity of their contributions. However, the value of the students' collaboration and interactions as they worked together as a group is more difficult to determine. This suggests a need for an assessment framework to evaluate the value of students' contributions and their interactions in wiki-based group work assignments.

The framework was built from a review of the literature, drawing on relevant research for assessing group work. Future studies will trial this assessment framework in a real unit setting that applies wikis for group work.

Keywords: assessment, wikis, group work

1 Introduction

The emerging research area of Web 2.0 technology adoption in higher education for group work is in part reflecting the changing employment needs in industries. People work collaboratively on projects, whether they are within the same organization or other institutions, using online collaborative and communication tools, such as wikis (Kille, 2006).

With the increasing adoption of online collaborative applications in the workplace (Venables and Tan, 2009), it is essential that students should have an orientation towards this globally connected

environment and are prepared to operate with it effectively.

Most universities deploy network infrastructures that provide online access for staff and students (Matthews and Schrum, 2003). The existence of network infrastructure together with the availability of various online collaborative-based Web 2.0 applications, such as wikis, enables universities to provide authentic online collaborative work experiences for their students.

The adoption of wikis to support teaching and learning in higher education has been the subject of extensive and prominent research from many different perspectives. Studies on wiki implementations in higher education include investigations of wikis to support teaching and learning (Cole, 2009), understanding the learner's acceptance of wikis in their learning process (Hartshorne and Ajjan, 2009), examining how wikis help learners complete their tasks (Larusson and Alterman, 2009) and exploring how wikis can be used to build learning communities (Wheeler et al., 2008).

Although collaborative learning mimics the real world workplace environment, there are issues with setup and adoption for students (Cajander et al., 2012) and often students are reluctant to work in a group (Caple and Bogle, 2013). One of the main reasons why students do not enthusiastically involve themselves in group work is related to the competitive nature of student learning (Smith et al., 2011). Students are commonly assessed on an individual basis and consider other students as their competitors. Students' entry to higher education is based on their individual academic performance. Such competition, however, can compromise effective group work functionality, in particular when students are asked to work with others in a group.

Recently, educational institutions have adopted wikis to support and evaluate group-based assignments (Waycott et al., 2010). Wikis enable educators to assess student's contributions by capturing and recording their contributions in the wiki's log file. Individual contributions captured in log files are usually assessed through measurable indicators such as counting the number of contributions, calculating the amount of time students engaged with the tool and determining how regularly students participated during collaborative tasks. Studies that focused on evaluating the value of students' contributions and interactions between members of a group in online tasks were rarely found.

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In this paper we present an assessment framework to evaluate wiki-based group work assignments. By combining quantitative analysis of students' individual contributions, together with qualitative analysis of group work interactions, this assessment framework provides a comprehensive set of rules to classify the value of student's individual contributions and their interactions.

We begin by discussing theory and related literature on group work and online group work assessment. The next section describes the development of our proposed assessment framework. Finally we propose future work and present our conclusion.

2 Research Background

2.1 Group Work

Jacques (1984), in his seminal study on *Learning in Groups*, defines a *group* as a collection of individuals that have some key attributes, such as: collective perception, needs, shared aims, interdependence, social organization, interaction, cohesiveness and membership. Another definition by Davies (2009) also points to shared aims and collaborative behaviours as key indicators for healthy group work performance.

Often the term *team* is used interchangeably with group. However, while groups and teams shared some common attributes, teams are usually created for specific purposes while groups could be formed spontaneously and not for a specific purpose (Davies, 2009). For example, in a sporting situation, a sports team is rightly called a team rather than a group because it has a specific goal to win its events and in the longer term to be the most successful club. However, in an educational context, the term *group* is commonly used. Typically, a group of students work together for one semester on a specifically designed group task. Therefore, in this paper the term *group* will be used.

Group work requires collaboration and cooperation (Mahenthiran and Rouse, 2000), each member of the group must interact, build understanding, present and challenge the ideas of other group members. As a result, group work often requires students to work on an authentic activity that could be useful for a student's later employability.

A group does not start off fully formed and functioning when it is initially created. In order to successfully work as a group, every member should recognise the stages of group work development. Tuckman's (1965) seminal study proposed the team stages model to address that challenge. The model consists of four stages, namely: *forming*, *storming*, *norming* and *performing*. In the first stage, team members meet for the first time to introduce and share their commitment. In the second stage, everyone begins to see themselves as part of the team and start to challenge each other. At the third stage, the team manages to have one goal and come to a mutual plan. Finally, at the performing stage, the team has reached a good performance through people working effectively together. A decade later, a fifth stage called *adjourning* was added to accommodate task completion and breaking up of the team (Tuckman and Jensen, 1977).

The benefits of group work in higher education have been recognised amongst educators. Students benefit from deeper learning because they have to learn and share knowledge to produce a collaborative product (Entwistle and Waterston, 1988). Group work also provides a more active learning environment as students share knowledge and experience (Ruel and Bastiaans, 2003). The capability to work as a group is an essential skill that recruiters and employers often look for (Maguire and Edmondson, 2001).

Although there are many benefits to be gained from group work, there are also issues that can occur. The motivation of group members has been noted to be one of the most serious problems in-group work (Hutter and Diehl, 2011). Some group members may be reluctant participants in assessment tasks and be uncommitted to the aims of the group (and the course for that matter). Motivational issues can arise as a result. Examples of motivational issues associated with group work are *social loafing* and *free riding*. These issues have received considerable attention in the literature (Hall and Buzwell, 2013, Jones, 2013). Social loafing occurs when capable students reduce their effort in a project while producing a good performance when working individually. The cause of social loafing is free riding (Mulvey and Klein, 1998), a situation where some of the members of the group might enjoy the benefits of a group mark without giving adequate contributions.

2.2 Assessment of Group Work

The assessment of online collaborative learning involves evaluating a *student's individual contribution* and their *final group product*. A student's individual contributions in group work include: adding text, images, links, changing layout, sharing ideas, allocating and managing tasks and integrating members' contributions. While the final group product of collaborative work can be found in the form of a software manual, book and case study report. The range of diversity of students' contributions and their final group product make assessment for online collaborative learning activities more difficult to design compared with individual assignment tasks (Swan et al., 2006). Assessment of group work should consider the balance of students' individual contributions and final group product (Trentin, 2009).

Fair assessment practice plays an important role in-group work assessment. Group results could be lower if one or more members do not adequately contribute. Students are often unenthusiastic about working in a group assignment, as they do not want to be graded based on other students' performances (Orr, 2010, Johns-Boast, 2010).

We propose that a comprehensive assessment of collaborative group work would involve three main considerations:

- Students' individual contributions
- Group interactions
- Final group product

as shown in Figure 1.

Monitoring a student's individual contributions can be achieved easily online by counting the number of their activities during group process (Macdonald, 2003). The drawback with this approach is excessive workload for academics. Research has been done by Farrell et al. (2013) to reduce this amount of workload by developing an online assessment tool called the Task Contribution System. This tool was designed to provide an evaluation system that enables an individual's contributions being assessed within a group task. However, merely counting contributions or activities cannot be used as an effective indicator of the quality of the contribution (Schrire, 2004). Therefore we argue that academics must also consider the value of a student's contributions.

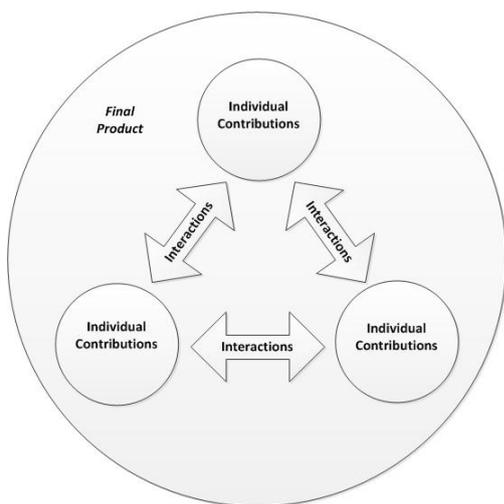


Figure 1: Three aspects of group work assessment

To complete a group task, interactions occur between the group members. That form of interaction can be described as cooperative or collaborative work. Cooperative works happens when group members complete their own tasks, but rarely interact and work on each others task (Arnold et al., 2012). See Figure 2.



Figure 2: Group working cooperatively

On the other hand, Figure 3 depicts collaborative work. It is achieved when group members contribute both to their own work and other member's work by interactively working as a group.

Judging the overall quality of the group product is the third component of group work assessment. This is normally achieved by measuring whether the final group product is complete (i.e. has met the task specifications) and is cohesive. Cohesiveness is an important consideration when evaluating group work, as it gives a measure of how well the group has worked together to produce a product in which the components are clearly connected and well.



Figure 3: Group working collaboratively

2.3 Online Group Work Assessment

Forum discussion boards were early online tools which were used in assessment of groups tasks. Forum discussion boards have been used to support collaborative learning since late 1990's (Meyer, 2010). As a result, there is an extensive literature that examines how forum discussions can be implemented to increase students' interactions (Rovai and Barnum, 2007), promote collaborative learning (Curtis and Lawson, 2001), assessed using a set of rubrics (Rovai, 2007) and evaluated through grading criteria to promote awareness during knowledge building process (Sorensen and Takle, 2002)

A recent study by Calvani et al. (2010) used a Moodle plugin to visualize forum discussion interactions enabling monitoring of group collaborative work.. This plugin is useful for educators to reduce paper work, allowing them to assess students' contributions by automatically classifying and tabulating student's activity into pre-defined categories. Although it is considered useful to encourage students to interact and discuss their ideas, the lack of facility to collaboratively produce the final group product is the main drawback of forum discussion boards. Therefore, evaluation of group work in forum discussions can only assess the idea development and not the actual final group product.

2.3.1 Assessment of Group Work in Wikis

Web 2.0 technologies provide teachers with a new approach to engage students to work in a group. By integrating this technology into instruction, classrooms move from teacher-dominated environments to student-centred environments (Keengwe, 2007). Whether it is participating in a class discussion or a forum discussion, the technologies available to students in a Web 2.0 classroom increases the amount they participate (Brodahl et al., 2011). By allowing students to use various forms of Web 2.0 technology for their collaborative tasks, teachers give students an opportunity to learn for themselves and share that learning with their peers.

A wiki is one of a suite of Web 2.0 applications that have been widely adopted in higher education (Ebner et al., 2008). A wiki is a browser-based software tool which enables users to collaboratively write, modify and delete content from a web browser using a simplified mark-up language or a rich text editor (Larusson and Alterman, 2009). A wiki also provides a history facility to keep track of the modifications made by different users and to enable changes to be reversed if necessary. Wiki pages can be created and edited using simple text editing facilities that are provided as part of the wiki software. The original philosophy of the wiki was one of complete openness, with any web user able to modify the content. However, a wiki can also be set up so that only certain users can modify the pages by giving different access to particular users (O'leary, 2008).

In an educational context, wikis can offer many benefits: they allow students to work together in a shared environment, with the progress of the work visible to all students, and to the teacher, at any time (Richardson, 2010). This visibility and sense of creativity and progress can be highly motivating (Trentin, 2009). Students can provide feedback on each other's work, and help to improve it (Lundin, 2008). Wikis also allow for web documents to be structured and organized in different ways, and to be updated regularly. They therefore provide a valuable way for groups of students, and their teachers, to collaboratively develop and maintain learning resources.

Although wikis have a lot of advantages, some students find wikis rather formal environments, and miss the interactive and community aspects of a forum discussion (Hemmi et al., 2009). Study by Cajander et al. (2009) reveals that there was a lack of structure in wikis, as a consequence students should read almost every part of the page to find recently added information. Furthermore, Vratulis and Dobson (2008) discovered that students might not all be able to play an equal role in making contributions to a wiki. Some students dominate and others fail to participate fully, which means that the final group product may not be representative of all students' perspectives.

A wiki is a suitable platform for this research because it is a naturally collaborative working tool in which log files record and track users' contributions so that academics can monitor and evaluate each student's contributions and activities. However, as far as the assessing the quality of students' contributions and

group interactions are concerned, wikis provide limited support. For instance in Mediawiki, several extensions and plugins were available to support group evaluation, however, most of them are either based on counting measurable activities or cosmetics related (e.g. monitoring and visualization) (Kubincova et al., 2012).

3 Framework Development

With the emergence and adoption of wikis to support online collaborative tasks, a new way of assessment has opened up. By analysing log files that capture online activities there is an opportunity to gain an insight into understanding the value of students' contributions and interactions.

A theoretical framework will be developed to evaluate three aspects of wiki-based group task:

- Students' individual contributions
- Group interactions
- Final group product

3.1 Individual Contributions

The basic method of assessing a student's individual contributions in a wiki-based group work assignment is by measuring the student's quantitative activities, such as: how many contributions they have made, and the size of their contributions (Trentin, 2009).

However, we argued that additional information should be added to gain deeper understanding on the value of student's individual contribution. Together with the basic method to evaluate student's contribution in wiki, we propose four additional attributes:

- Number of contributions
- Size of contributions
- Types of contributions
- Purposes of contributions
- Regularity of contributions
- Relevance of contributions

3.1.1 Types of Contributions

Commonly occurring contributions in wiki-based tasks are adding text, images or links as well as editing, deleting and moving contents.

Several studies to identify students' contributions in wikis have been performed (Pfeil et al., 2006, Ehmann et al., 2008, Arazy et al., 2010). These studies identify the types of student's contributions such as: add, delete, proofread, improve navigation and add link to references.

The study by Calvani et. al (2010) on group work interaction proposes a set of *thinking types*. These include: explain, connect, ask, edit, organize, suggest, revise and summarize. These thinking types were used to label each segment of a student's conversation in a forum discussion. By utilizing these pre-defined labels for each conversation segment, the type of students' thinking could then be mapped. Judd et al. (2010) also provided a similar method to categorise students' contribution based on content analysis.

There are a lot of thinking types defined in Calvani's et. al (2010) study as the nature of forum

discussion board is more of a *conversational style* (e.g. propose idea, explain, argue) rather than *writing style* used in a wiki (e.g. add, delete, edit). We draw on these thinking types, but simplify them for our purpose of classifying type of a student’s action while they are writing their contribution in wikis. Our proposed types of contributions are:

- Add: add one complete sentence or more.
- Edit: add, delete or move one word or more (but not a complete sentence), typo and grammar correction.
- Delete: delete a sentence or more.
- Move: move a sentence or more to other section of the text.

We outline the types of student contributions and its description in Table 1. For any activities which involve students working on their own contribution, we put label 0 after categories (e.g. A0, E0) while for the activities on other member’s contribution we use label 1 (e.g. A1, E1).

Types of Contributions	Description
A0	Add one sentence or more <i>to their own work</i>
A1	Add one sentence or more <i>to other member work</i>
E0	Add, delete or move one word or more (but not a complete sentence), typo correction, grammar, punctuation mark <i>of their own work</i>
E1	Add, delete or move one word or more (but not a complete sentence), typo correction, grammar, punctuation mark <i>to other member work</i>
D0	Delete a sentence or more (i.e. : paragraph) <i>of their own work</i>
D1	Delete a sentence or more (i.e. : paragraph) <i>of other member’s work</i>
M0	Move a sentence or more (i.e. : paragraph) <i>of their own work</i> to other section.
M1	Move a sentence or more (i.e. : paragraph) <i>of other member work</i> to other section.

Table 1: Type of students’ contributions

3.1.2 Purposes of Contributions

The second attribute of a student’s individual contributions is its purpose. This attribute is used to categorise a member’s participation based on the characteristics of their contributions. Meyer (2010) comments that there is a lack of communication features in wikis that prevents discussion amongst group members. A study by Tuckman and Jensen (1977) reveals that groups form and build understanding by knowing each other, managing and reorganizing

their work. This is an indication that during wiki construction there is more than just content produced.

Therefore, we propose three labels to identify students’ contributions based on its purposes:

- Content related (e.g. adding text, images, links)
- Social (e.g. greeting, asking questions)
- Organizational (e.g. task distribution and due date reminder).

By labelling students’ contribution by the purpose of their activities, we can gain insights to each group members’ role (e.g. content builder, proof-reader).

3.1.3 Regularity of Contributions

Regularity is a measure of the distribution of a group member’s contribution over time. Regularity can be used as an indicator of collaborative behaviour. Calvani et al. (2010) in their research show that regularity can be considered as sign of individual responses to group needs.

Regularity could also be used to identify student’s motivation. Hutter and Diehl (2011) argue that evenly distributed contributions over time indicates a high motivation to complete the group task.

3.1.4 Relevance of Contributions

In a group assignment, students are required to contribute to the completion of a task. It is important that the contribution is relevant to the task and it has an appropriate level of quality. Together these give a measure of the value of the contributions. A valuable contribution should enrich existing work not just adding the length of the text.

3.1.5 Summary

Table 2 shows the summary of attributes of a student’s individual contribution.

Attributes	Description
Number of contributions	A count of contributions made.
Size of contributions	A measure of the size of the contribution (number of characters).
Type of contributions	Categories of contribution (e.g. add, edit, delete, move)
Purposes of contributions	Characteristics of contribution (e.g. content related, social, organizational)
Regularity of contributions	Distribution of contribution over time
Relevance of contributions	Extent to which the contribution improves the richness of current work

Table 2: Individual contributions

3.2 Group Interactions

The second aspect of wiki-based group work evaluation is group interaction and behaviour. In this aspect, there will be three attributes used for evaluation:

- Balance participation
- Cooperative interaction
- Collaborative interaction

3.2.1 Balance Participation

Developing a wiki as a collaborative process could end up as an unbalanced set of group activities (Calvani et al., 2010). This is because not all of the members will equally contribute during the group process. Some of the members will dominate the group by contributing large amounts of content while others will participate less.

In a healthy group, all members should participate equally without monopolizing or not contributing. Therefore, the attribute we introduce here is *balance participation*. It can be derived from both the contribution types and the purpose of contributions.

3.2.2 Cooperative Interaction

One of main drawbacks in wikis is the reluctance to contribute to other group member's work. Students report that shared editing takes more effort rather than writing their own task (Ma and Yuen, 2008). Minocha and Thomas (2007) found that contributions from other students are not always accepted as constructive feedback. Wheeler et al. (2008) indicate that group members were resistant to having their contributions changed by their peers. While Twu (2010) suggests that cultural background plays an important role in this behaviour.

A study by Valente et al. (2012) reveals that the nature of activities influence interactional behaviour. If the task is not designed to promote cooperative behaviours, group members could work independently to complete their task. This type of group interaction can be identified as cooperative interaction. This type of interaction can indicate when group members are mostly concerned with their own task.

3.2.3 Collaborative Interaction

Collaborative behaviours have greater potential to improve the final product (Arnold et al., 2012). The more interactions happened in the group, the more chance for the group to reshape the content for a better, more cohesive product.

Consequently, if students are reluctant to work on each other's work then the final product may appear to lack cohesion. In collaborative work, it is vital that members show reciprocal trust and sense of belonging in the group.

Collaborative behaviours can be identified by assessing whether the members' contributions enrich other members' work. Recent studies by Li (2012) and Mitchell and Carbone (2011) found that assignment specification should be carefully designed to promote collaborative learning.

3.2.4 Summary

A summary of the proposed attributes for assessing group interactions is shown in Table 3.

Attributes	Description
Balance of participation	Level of balanced/equal participation in the interactions
Cooperative interaction	Amount of the time group members work on their own task
Collaborative interaction	Amount of the time group members take responsibility on other members' task

Table 3: Group interactions/behaviours

3.3 Final Group Product

The evaluation of a collaborative task can in part, be assessed by judging the completeness of the final group product (Macdonald, 2003). This type of assessment checks whether the task meets all the assignment requirements. However, evaluating the functionality of the final group product only illuminates the *completeness* aspect of a collaborative work. It can not determine how valuable students' interactions were on the wiki during construction of the final product. Completing a wiki-based assignment, as a collaborative activity, is made up from lots of individual contributions from group members. As a result, a good final group product should show cohesiveness (integration and synthesis) from several individual group members.

Therefore, in addition to completeness, we proposed cohesiveness of contributions as an attribute to evaluate the final group product. Table 4 shows the summary of the propose attributes.

Attributes	Description
Completeness	Degree to which the final group product meets task specification
Cohesiveness	Degree to which individual contributions' have been integrated and synthesised

Table 4: Final product attributes

4 The Assessment Framework

We have described three aspects of assessment of wiki-based group work. Table 5 shows a complete picture of the proposed assessment framework that includes all aspects of assessment, attributes for each aspect.

There are three aspects of evaluation proposed: a student's individual contribution, group interactions and the final group product. We have argued that the first aspect, student's individual contribution, consists of six attributes: number and size of contributions, type of contributions (add, edit, delete and or move), purpose of contributions (content-related, social and organisational), regularity of contributions (very frequent, frequent, infrequent, no record)) and relevance of contributions (extent to which the contribution improves the richness of work).

We argue that the second aspect, group interactions, consists of three attributes: balance participation (level of balanced/equal participation across all members), cooperative interaction (working on their own task) and collaborative interaction

	Aspects of Assessment	Attributes	Description
Individual Contributions		Number of contributions	A count of contributions made.
		Size of contributions	A measure of the size of the contribution (number of characters)
		Types of contributions	Category of contributions (e.g. add, edit, delete, move).
		Purposes of contributions	Characteristic of contributions (e.g. content related, social, organizational).
		Regularity of contributions	Distribution of contributions over time.
		Relevance of contributions	Extent to which the contribution improves the richness of current work.
Group Interactions		Balance of participation	Level of balanced/equal participation in the interactions.
		Cooperative interaction	Amount of the time group members' work on their own task.
		Collaborative interaction	Amount of the time group members take responsibility on other members' task.
Final Product		Completeness	Degree to which the final group product meet task specification.
		Cohesiveness	Degree to which individual contributions' have been integrated and synthesised.

Table 5: Summary of proposed assessment framework to evaluate wiki-based group work construction

(contributing to another member's task). The last aspect, the final group product has two attributes: completeness (meets project specifications) and cohesiveness (level of integration and synthesis).

5 Conclusion and Future Work

This paper describes the development process of an assessment framework, which can be used to evaluate the value of a student's contributions and their interaction during wiki-based group work construction.

This study expands the typical method of counting student's contribution in-group work assignment, by measuring quality of students' contributions together with their interactions with group members.

We have proposed that the additional attributes can be used to obtain a better, more realistic assessment of the value of students' contributions and their interactions.

The development of this framework seeks to benefit three main stakeholders: educators, students and software developers:

- For educators, an audited set of principles and guidelines will assist them in determining a student's contribution and the value of their interaction during group work.
- For students, this study will provide guidance on how their group work will be assessed.
- For software developers, this study will provide insights into the features that could be included in the development of collaborative software used for assessment purposes.

Further work will involve trialling this assessment framework on a unit that uses wiki-based group work assignment. At this stage a postgraduate unit that focuses on digital marketing has been selected. Ethics has been sought to analyse the Wiki log files for

students who completed this unit in 2012 and 2013. Analysis of the log files will be achieved by applying the first two dimensions of the framework, and will be reported in subsequent publications.

This will provide some insights into which attributes should remain or be removed from the framework.

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